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PRODUCTION FOR QUALITY.

CERTAIN countries in the tropics are noted for the quantity of their agricultural products while others are renowned, not so much for the quantity as for quality. This circumstance appears to be deserving of greater attention than is usually given to it. To take concrete examples, we may cite the Gold Coast, which is noted for the quantity of its cacao output, in contrast to Venezuela and Ecuador which, although they do or have produced very large quantities are chiefly famous for their cacao's quality. Again, the southern United States produce very great quantities of medium cotton; but this is inferior to the longer, stronger and usually cleaner lint of Egypt, and much more inferior to the Sea Island cotton of the West Indies although the output of the last-named grade is relatively infinitesimal. Another example is to be seen in the case of copra. Although the greatest quantity of copra is produced in the Philippines, it is the Malabar copra of Southern India and some grades of Ceylon copra that command the highest prices in the worlds' market; there are similar distinctions existing between average Indian teas and Ceylon teas; Blue Mountain or Colombian coffee and Rio-Santos (basic Brazilian grades of coffee). What are the reasons for these differences? We know in a general way, but only in a general way. The reason for the lower quality of Gold Coast cacao is partly due to the fact that it is produced by small native growers who do not always give adequate attention to fermentation and grading, while considerable deterioration is sometimes caused by "country damage" owing to the long distances of transport. These facts, however, do not serve for a complete explanation. It is well known that Ecuador cacao is very poorly fermented and prepared, and it is also known that but little attention is given in this country to the cultivation of the plantations. The true explanation lies most probably in subtle conditions of soil and climate. The variety or strain of the plant itself is also responsible, but scarcely to any great extent in the case of cacao but if it be true that the Arriba and Machala grades of differing values come from trees of similar characteristics. In order to solve the question completely it becomes necessary to analyse what is meant by quality. In doing this we must distinguish between the factors or characteristics which constitute the attribute of quality and what it is that gives rise to these factors or prevents their manifestation. In most crops the factors or characteristics constituting definite high standards of quality seem for the most part to be chemical, especially in regard to tobacco, oil nuts and cacao; physical damage, impurities, &c., produce low quality (negative quality). As regards the natural circumstances that give rise to quality factors, it is evidently a question of a resultant between genetic constitution and environment. Although we stress the importance of environment in this discussion, the fundamental character of the genetic or plant constitutional aspect must not be forgotten: it has been shown to be especially significant in the case of cotton. Tobacco, however, does seem to be a plant in which environment plays the major part in determining quality, the soil being to a very large extent the determining factor in this instance. In the case of cacao, quality lies in colour, strength, acidity, &c., thus it is largely a bio-chemical problem of the individual bean having as well, however, psychological features in respect of the broker and the manufacturer. Quality is clearly a very abstruse problem and the attention that is being given to its investigation at the Imperial College of Tropical Agriculture is likely to provide interesting results. All crops, in all stages, need consideration. Concerning coffee, climatic

conditions are essential factors as they are in the case of tea. Variety or type is also important, however, in the case of both these crops. Arabian coffee only will give high grade coffee; Robusta coffee however perfect the meteorological conditions will not produce quality. Quality in tea and coffee is, when analysed, largely a bio-chemical phenomenon connected with essential oils and complexity of composition. In regard to quality in relation to the coconut we are very much in the dark. One important aspect in this connection is the relative (constant and variable) quality of the nuts themselves in regard to oil content. In tropical America the San Blas coconut of Panama has a very high reputation for oil yield. These nuts are not large in size but they contain a very high percentage of "meat" and therefore of oil. The thickness of the "meat" is most striking in these nuts. Is this an hereditary feature or is it produced by conditions of environment. The experimental work that is being done in Madras and Ceylon on this and allied problems should be followed by all coconut planters. As to quality in sugar this is largely a matter of chemical technology. It is principally a question of money in order to produce good sugar of high polarisation; but not entirely; colloidal impurities are difficult to remove however complete the machinery and however technical the control. It is the cane which contains the substances inimical to high quality. Quality in regard to sugar needs research just as it does in the case of other products. It should be realised, however, that the quality of sugar is a question of impurities, whereas in the case of most other products it is a result of substances being absent. Considered broadly the production of quality calls for chemical analysis, genetic synthesis, proper ecological conditions for the crop, proper agronomic attention, protection from weather and parasitic damage, skill in preparation: in fact the requirements for quality are in principle the same as those needed for sound and scientific production. As a consequence of this we find that some countries which in the past have been merely big *extensive* producers, are becoming producers of better quality chiefly as the result of the fact that better agriculture has become necessary for the maintenance of output and progress. A collateral effect has been to improve quality. This is to be seen in the case of Gold Coast cacao and Nigerian cacao. But there is a limit to this sort of quality; management and skill may prevent the spoiling of the fair but only science can indicate the way to transform the fair into the excellent. Needless to say, the great economic advantage of quality is that it possesses a special market significance. It means a premium. It often means a monopoly and consequently a much wider and less variable margin between cost of production and value. This is an age of novelty and luxury. Selection for quality pays. Special grades of distinction can always be sold because they can always be advertised, directly or indirectly. Small total production for quality with a high cost of production may answer on many an estate. Only a big total production with a low cost of production is safe where quality and distinctiveness are not aimed at. Even then there must be a market. Is this not pertinent at a time when many industries are suffering from depression?

RECENT PROGRESS WITH INSECTICIDES.

C. L. WITHYCOMBE, PH.D., D.I.C.

For many years the employment of insecticides as a check upon the ravages of various insect pests has been recognised as a necessary part of agricultural practice, and large quantities of chemical substances are annually consumed in this way alone. In temperate climates the expenditure is no doubt amply justified by the subsequent beneficial results, and most growers would consider the cost of spraying as an essential part of their annual running expenses. This particularly applies to fruit growing in temperate and sub-tropical countries where the effective use of insecticides may make all the difference between success and failure. In the tropics, however, matters are somewhat different. Spraying is much less frequently resorted to and in fact is, in many cases, quite impracticable. As a result, many tropical planters are unaware of the progress which has been made and the success which has been obtained in this direction. One finds obsolete sprayers still being employed, while the individual's choice of insecticides is often extremely limited. Bordeaux mixture is commonly considered as a sovereign remedy for all evils.

The faith which is placed in the latter is amazing. Although it is no doubt excellent when employed in its true sphere, as a fungicide, yet its effects when inappropriately applied may yield far from pleasing results. The correct application of Bordeaux mixture is against rots, mildews and other fungi. Against insects it has little or no killing power and it may sometimes even favour increase of the pest. Such frequently occurs when scale-infested trees are sprayed with this mixture. The scale insects increase instead of decreasing in numbers and the grower is naturally disappointed at the outcome of his labours. Ever after he regards spraying with disfavour and scepticism. The probable reason of failure is not far to seek. Scale insects are controlled in nature to a large extent by certain insect-destroying fungi and especially in humid climates, are these beneficial fungi of importance. Bordeaux mixture, in virtue of its fungicidal properties, arrests further spread of the insecticidal fungi and thus the scale insects are allowed to multiply unmolested by their fungal enemies.

To spray without definite object and knowledge of requirements is a waste of time and money. Before attempting such control measures it is necessary to consider whether the effective application of a spray is practicable, whether it

is likely to prove financially worth while, and finally what form of insecticide is the best to employ under the circumstances. The first two questions can only be decided by the grower himself with a knowledge of the means at his disposal. The last depends on the nature of the insect pest present.

Briefly it may be said that insecticides are divided into two main classes (1) Stomach poisons, or substances which are eaten by the insect with its food, and (2) Contact poisons, or substances which kill after coming into contact with the insect's body. Stomach poisons are used against leaf-eating insects, such as caterpillars and various beetles. The poison is sprayed on to the leaves of the infested plant and the insects are killed after having eaten the poisoned leaves. In this class would be placed arsenical and other similar insecticides. Contact poisons are used against those insects which do not as a rule devour parts of the plant, but which obtain their food by sucking the plant juices or in some other way. Against such insects stomach poisons would be useless since the poison would not be taken into the insect's system in feeding. Contact poisons might be used against all insects, both biting and sucking, but owing to their frequent difficulty of application and for other reasons stomach poisons are always used when possible. They are more certain in effect. It is necessary to use contact poisons against thrips, aphids, scale insects, mealy bugs, &c., the commonest insecticides employed for this purpose being various oil-soap emulsions and nicotine mixtures. The object of the present article is to indicate a few of the recent additions and improvements which have been and are being developed.

It should always be borne in mind that whatever degree of perfection may be attained in insecticides and insecticidal methods, spraying and other similar artificial controls will never do more than afford temporary relief from what are really the results of faulty agricultural conditions. It is true that in the majority of cases we do not know what these conditions are or by what means they can be rectified. The underlying causes for the outbreaks of many insect pests are still very obscure and it is only when these have been elucidated and fully understood that we can hope to control agricultural pests upon a sound basis. It is far preferable to keep down the numbers of a pest and prevent its increase by good cultural methods than to invite disaster by careless cultivation and then hope to stave off the evil effects at the last moment by some miraculous panacea. A natural balance is the object to be aimed at, but until this can be satisfactorily accomplished it is necessary to utilise such artificial aids as we have to stabilise matters.

One of the most important contact insecticides has been nicotine, variously combined with soap and other media. At one time it was a cheap commodity owing to the fact that it could be extracted with little difficulty from the waste portions of leaves and stems left over in tobacco manufacture. The chief varieties of tobacco grown nowadays, however, contain such small quantities of nicotine that tobacco factory waste is scarcely worth extracting. The price of nicotine has, as a consequence, risen considerably, much to the concern of the agriculturalist to whom the product is a necessity. One now looks for a substitute, some plant yielding a toxin equal to or better than nicotine, or else tobacco of high nicotine content must be grown purely for agricultural purposes, as has been done on a small scale in many countries already. There are certain difficulties, however, with regard to trade in nicotine. Substitutes are by no means easy to find, although a thorough and systematic search has been made by several competent scientists. Important results have been arrived at and incidentally our knowledge of the physiological action of insecticides upon insects has been considerably augmented. This last aspect is likely to assume increasing importance in the future and it opens up a vast field of necessary research.

Foremost among insecticidal plant products must be placed Derris. This is obtained from the roots of an East Indian plant, *Deguelia elliptica*, locally known as "tuba" or "toeba," which has for centuries been used by the natives as a fish poison. Comparatively recent investigations have shown it to be superior to nicotine in many respects as a contact insecticide although it is useless for fumigation purposes. Several well-known proprietory insecticides contain it as active principle. With the present demand for the dried roots it is surprising that its cultivation in parts of the tropics has not been readily taken up. As far as is known there is no difficulty in its culture, yet so far no serious attempt appears to have been made to grow it commercially. The experiment may be recommended as a promising one, a ready sale of the roots being a fair certainty. Present market supplies are derived from roots collected by natives in the bush, there being no guarantee that the material supplied is unadulterated.

Another recently developed insecticide is Pyrethrum. This is obtained from the flowers of various Compositae which have long been grown in the Mediterranean region. It is an active contact poison when freshly prepared but it rather quickly loses its efficacy if exposed for any length of time to the atmosphere.

Fumigation is a valuable method, where applicable, of destroying certain kinds of pests which do not yield readily to ordinary contact poisons or which are difficult to spray. In this category would be placed many important citrus pests, scale insects and mealy bugs, under conditions such as obtain in the Southern States of America where individual citrus trees are of great value. In temperate countries fumigation is carried out in greenhouses and is a comparatively simple operation. The house is closed hermetically and the plants are subjected to the action of the fumigant for varying periods until the insects are suffocated and killed. Where citrus trees are grown in the

open it is possible to cover the infested tree with a canvas tent under which the fumigant can be released. Such is common knowledge.

One of the latest improvements in fumigation has been brought about by the introduction of calcium cyanide. This is, in dry weather, a great improvement on the old method of fumigating by means of hydrogen cyanide liberated from potassium cyanide by the addition of acid. It is far cheaper and more easily worked. According to Quayle, the powdered calcium cyanide is dusted under the tent enclosing the citrus tree and is allowed to act for about forty-five minutes, after which the tent may be opened up and removed. In wet weather slight injury to foliage may occur. Calcium cyanide can also be employed in other fumigating processes and is being so used more and more extensively owing to its cheapness, convenience and other advantages.

A paper by Speyer and Owen (1924) indicates that naphthalene can be used effectively against red spider in greenhouses, and if vaporised at 30°C to 40°C (86°F to 104°F) no injury to foliage results. Remarkable is the fact that the eggs of the red spider mite are also killed if exposure to the naphthalene vapour is continued for a longer period, (3 to 6 days). The method as yet does not seem to be applicable to tropical work, although the discovery is an interesting one.

Against soil grubs, wood-boring insects, &c., paradichlorobenzene has of late come much to the fore. The product is cheap and very efficient. It appears to be harmless to plants and to human beings when used in ordinary quantities. Apparently the first successful results in using this as a soil fumigant were obtained by Mr. E. Jarvis in Queensland, Australia. He obtained most strikingly good results against sugar-cane grubs by injecting small quantities of the chemical at distances of four inches from the cane stools and six inches deep. Details of his methods and results are given in the "Louisiana Planter and Sugar Manufacturer" for December 1st, 1923. A further and rather remarkable remedy for cane grubs is given by Illingworth and Dodd in Queensland, namely the use of arsenic compounds in small quantities. These no doubt require to be applied with great caution since they are poisonous to plants as well as to animals.

In concluding these notes mention may be made of the distribution of arsenical dusts by means of aeroplanes. So far this method can be considered to be still only in the experimental stage and reports are not definite as to the success or otherwise of such operations. For covering large areas rapidly and evenly with poison dust the aeroplane would seem to be incomparable, and as regards cost, it would probably work out considerably cheaper than a ground machine. *Bulletin No.* 1204 of the U. S. Dept. of Agriculture gives full details of the dusting of cotton plants against cotton leaf worm and describes how the arsenical powder is blown down over the cotton plants as a dense fog during the night. The writers seem to consider that in the use of aeroplanes lies a hopeful line of control for the notorious cotton boll weevil.

MAURITIAN PEN MANURE.

PROFESSOR F. HARDY, M.A.

There is no need to extol the many virtues of pen manure, or to reiterate the need of its greater employment in tropical agricultural practice. The main problem that confronts the planter in these days of mechanical tillage is how to manufacture larger quantities of pen manure with diminishing numbers of farm animals.

Bacterial transformations in the making of pen manure.—It is well known that pen manure consists of two main components, animal excretions and litter. Of the former, urine is by far the more important. It not only contains compounds of immediate fertilizing value, but also furnishes nitrogen to the organisms that bring about the decomposition of the cellulose of the litter into brown humus-like substances. Much of our knowledge of the cellulose-decomposing organisms is due to the researches of Dr. Hutchinson and his co-workers at Rothamsted. These investigators have demonstrated that four main factors control the rapid multiplication of the more effective bacteria capable of decomposing cellulose. These factors are (1) an adequate supply of air, (2) an adequate supply of moisture, (3) a sufficiency of inorganic, or simple organic, nitrogen compounds, and (4) the absence of certain specific toxins, such as reducing sugars and *higher* organic nitrogen compounds. In the absence of an adequate nitrogen supply, however, it is interesting to note that deficiencies may be made up by the activity of certain nitrogen-fixing bacteria which can thrive on the first-formed decomposition products of cellulose, provided these products include readily oxidizable substances. Thus the nitrogen-fixing bacteria may work in conjunction with the cellulose-decomposing organisms, and thereby augment the initial supply of suitable nitrogenous material in the medium.

Artificial and Mauritian pen manure.—A natural outcome of the investigations of the Rothamsted workers was the formulation of a method for making artificial farmyard manure by treating straw with water, ammonium sulphate and finely ground limestone. This process has recently been patented, and its application will probably greatly aid in solving the problem of maintaining the humus supply of cultivated soils. In quite another connection, yet closely related to this subject, the Rothamsted researches have fully confirmed the soundness of a practice advocated many years ago by certain planters in Mauritius, whereby the output of pen manure on sugar-cane estates may largely be increased. Briefly, the practice consists in spreading machine-cut cane trash, herbage, or bush to a depth of 2 feet on the floor of a covered pen. Cattle are turned into the pen daily for a fortnight. At the end of this period, the urine-soaked litter is transferred to a pit whose floor and sides are composed of concrete or stone. In the pit, the moist material must not be stacked too loosely, else excessive decomposition, leading to "fire fang," may occur.

Nor must it be packed too tightly, for exclusion of air may result in the formation of a sort of silage, owing to the development of an undesirable type of bacterial activity. The pen is afterwards again spread with cut litter, and the cycle repeated. When the contents of the pit have broken down properly, the manure is carted to the fields for spreading, or suitably stored until needed. The changes that go on in pen and pit are probably somewhat as follows. The simpler nitrogenous compounds present in urine, chiefly urea, are either immediately utilized by cellulose-decomposing organisms naturally present in small numbers on the litter, or are quickly rendered available by conversion into ammonium compounds by fermentation. The organisms break down some of the cellulose of the litter, and thereby produce a suitable medium for the growth of nitrogen-fixing bacteria. These furnish simple nitrogenous compounds which quickly augment the nitrogen supply of the original medium, and allow of the further multiplication of the cellulose-destroying organisms. The process is therefore cumulative, and eventually the greater part of the litter is changed into humus. The end product is not only in a very suitable form for application to the land, but it also contains much greater amounts of nitrogen than can be accounted for by the relatively small quantity of urine originally present in it, because the nitrogen-fixing bacteria have also added their share of acquired nitrogen to it.

Advantages and disadvantages of the Mauritius method.—The chief obvious advantage of the Mauritius method for making pen manure is that much larger quantities of cellulosic material can be converted into manure by the penning of a limited number of animals, than is possible when the customary process of preparing pen manure is practised. Moreover, the Mauritius method may be adapted to the conversion into manure of widely diverse kinds of cellulosic material, such as straw, trash, grass, roughage, bush, and possibly even megass. Strictly aerobic and properly moist conditions must be maintained, however, for the method to prove successful. Its most serious disadvantages are the high initial cost of the trash cutter, pen and pit, and the expense of handling the manure during its preparation. On small estates, or under systems of very intensive cultivation, the Mauritius method may not, of course, be practicable, because it may not be worth while to use valuable land for producing the requisite material for litter.

A Mauritius pen in Trinidad.—Through the courtesy of the Manager of the Ste. Madeleine Sugar Company, the writer is able to present the following data relating to a large-scale experiment carried out at Cedar Hill Estate, Trinidad. The plan of adopting the Mauritius system for increasing the supply of pen manure to the sugar-cane lands of the Company was suggested in 1923 by Mr. G. A. Jones, Agronomist in charge of Field Experiments. The pen is 100 feet long by 30 feet wide. It is divided into two equal compartments. Alongside the pen, and running its whole length, is a pit, 20 feet wide and 6 feet deep. A low wall surrounds both pen and pit. The floor and wall are made of concrete, and the whole is sheltered by a galvanized iron roof. A trash cutter and blower-elevator, driven by an oil engine, are suitably housed in a small shed adjacent to the pit. In operation, one of the compartments of the pen is initially filled to a depth of 3 feet with finely chopped litter. It is generally not necessary to add water to the litter, but provision is made for a water supply to be used when megass is mixed with the litter, and during dry months when vegetation is parched. Cattle (20 head) are turned into this compartment daily for 14 days, litter being added each day. The second compartment of the pen is then put into commission, and the stock turned into it, whilst the contents of the first are transferred to the pit. By this plan, 2,000 tons of manure can be made per annum by 20 head of stock, or 100 tons per annum per head. By the ordinary method of preparing pen manure, only 20 tons can be made per annum per head, so that the Mauritius method is five times the more productive, under the conditions of this particular experiment. It is not necessary here to record the cost of cutting and carting trash and grass for litter, and of emptying the pen. The manager of Cedar Hill Estate, Mr. E. E. Fabien, is convinced that, if a sufficient quantity of grass or other vegetation suitable for conversion into manure, can be grown on waste lands bordering railway lines, the Mauritius system will provide him with enough pen manure to apply to ratoons, as well as to plant canes. Formerly it was difficult to get sufficient material even for manuring plant canes alone. Furthermore, the new method will permit substantial reductions in the necessary quantity of stock, and it is expected that it will largely reduce the cost per ton of sugar-cane produced.

As regards the comparative fertilizer value of pen manure made by the Mauritius method, the

Sample.	Moisture.	Ash.	Organic matter.	Soluble humus†	Total Nitrogen.	Nitrogen as Ammonia.
	%	%	%	%	%	%
A	74·2	7·9*	17·9	12·0	0·184	0·005
B	78·0	3·8	18·2	12·3	0·216	0·002
C	77·0	4·3	18·7	14·0	0·220	0·0025
Average English farm-yard manure	76·0	6·0	18·0	—	0·620	0·020

results of analyses performed by the writer and recorded in the accompanying table, furnish sufficient evidence to prove that it may differ but little from, and may be even superior to, pen manure prepared in the usual manner. The

* Containing extraneous clay, 2·7 %

† Determined by Piettre's method of extracting humus with boiling pyridine.

material analysed was obtained by the method of sub-sampling from three 60-lb. samples of manure obtained from (A) an ordinary covered pen, in which fodder and bedding had been trampled by stock for three months, (B) one of the compartments of the Mauritius pen after three weeks trampling, and (C) the pit, where manure similar to (B) had been allowed to decompose for an additional ten days.

It should be noted that sample A differed from the others in being coarse and long in texture. One of the main factors for success in the Mauritius method is a comparatively fine texture in the pen litter. This enables it to take up and to distribute the urine of the animals that trample it, and thus to induce uniform decomposition throughout the mass. In conclusion it may be stated that one week's storing in the pit usually suffices for the production of a satisfactory manure. The material should then be spread at once, or piled in heaps until needed. To prevent "fire fang," and to minimise wasteful decomposition, the manure store-heap should be compacted during its formation by passing the carts across it. The heap may further be protected by covering it with a layer of soil, and by erecting over it a rough shed to shelter it from rain.

The writer's thanks are due to Mr. G. A. Jones of the Ste. Madeleine Sugar Company, and also to his colleagues, Messrs. S. F. Ashby and J. S. Dash for corrections and additions to the original draft of this article.

A GUATEMALAN COFFEE ESTATE.

[*The following information, collected by a member of the College Staff during a tour in the Cordillera Mountains on the Pacific side of Guatemala, will be of interest to many readers of this journal.*]

The estate visited has 2,000 acres planted in coffee, and the property extends from 2,000 to 5,000 feet above sea-level. The estate buildings are connected by a rough road to the railway some 15 miles away, at a point between the south-west Mexican border and San José, the chief Pacific part of Guatemala.

The soil and climate of this estate are ideal for the production of high-grade Arabian coffee. The soil is of volcanic origin, light, deep, and partly on account of the steep slopes, of good natural drainage. The climate is sub-tropical. A special and regular feature of the weather conditions is sunshine every morning until about noon, and then heavy showers of rain in the afternoon or evening.

The coffee plants are raised in seed-beds and nurseries situated at different points on the estate. The seedlings are planted out, when one to two years old, in holes manured with coffee pulp, at a distance 12 feet by 12 feet. The coffee plant has a deep tap root, and the subsoil must be free from stones.

As soon as the young plants are well established, the single stem is bent over by means of a pronged stick. This induces the development of secondary stems from the base of the primary one. The fields are cutlassed and weeded three times a year.

Pruning is important. An ideal coffee tree, according to Guatemalan views, should have four stems, about 5 feet high, and no 'crinolines' (lateral branches near the base). Pruning is done to secure this form, but it is not necessary in the ordinary way to do any top pruning.

Shade is necessary. On this estate bananas have in the past been largely employed, but now a leguminous tree (*Inga* sp.) is being substituted in preference. Bananas are not popular where the coffee is the main consideration. The shade trees are planted about 40 feet apart.

The older trees are mulched with leaves. Chemical manures are not employed, because it is held that they would be washed out of the soil before the plant could make use of them.

A coffee tree comes into bearing at three years, and its life may be forty to fifty years. A good tree will yield 2 lb. of *dry* coffee per annum. One labourer may pick 100 lb. of wet coffee a day. The picking seasons begin about June, but varies with the altitude.

It is very important to pick Arabian coffee at the exactly right moment. A ripe coffee berry, ready for picking, is claret-coloured.

On this estate water supply and water-power are plentiful. The coffee is therefore washed to the buildings from the mountain sides, in iron pipe lines. This is a great saving in labour. Another saving of labour is a tunnel cut through the side of a high ridge, and thereby establishing easy communication between two parts of the estate which would otherwise be separated.

The estate labourers are almost entirely Central American Indians (Quichés). They use in their field work a so-called spade-hoe, especially made by Mills & Co. of London, to suit the physical strength of these small men. A sufficient number of labourers for routine work live on settlements on the estate ; but at picking time larger numbers are required, and agent senlist them in the villages of the interior by means of advances. A labourer gets up to 50c. a day but they are nearly all kept in debt for control purposes. If there is any difficulty in recruiting labour for picking, the Guatemalan officials force the labourer under threat of conscription in the Army, or even imprisonment. So the planters have little to worry about in regard to labour-supply.

The buildings and machinery of the estate under consideration are excellent in every respect. In fact the buildings constitute a small township, with its own roads, electric light, doctor, commissary and so forth. The coffee is washed and fermented in concrete tanks. There are centrifugal driers, polishers, pulpers and graders. Power is derived from a turbine and motors. The lower grade coffee is dried in sloping cement floors, provided at one end with lean-to roofs in case of rain.

A stem disease, *Tora vastatrix*, and a disease of the leaf, *Flavium stilbum* occur on the lower and middle lands. There is no *Hemileia vastatrix*, a disease which caused the coffee industry of Ceylon to be abandoned. A black fungus was observed on the flowers and berries of trees at 5,000 feet during the writer's visit, but this had not been investigated. It was causing some concern, for the highest grade coffee comes from this latitude.

Well prepared and high-grade coffee should be bluish in colour, bullety in feel and weight, and uniform in general appearance. Most of the coffee produced on the estate under consideration is of this character. A feature of high grade coffee is the essential oils in the seed-coat, as well as the caffeine in the body of the seed. High grade coffee generally has a bitter taste, which is only fully appreciated by connoisseurs.

The information presented in these notes appears to be of special value, in that it shows that for the production of high-grade coffee, that is for the production of *quality*, certain special conditions are absolutely necessary. These include (in the tropics), conditions of altitude and climate soil, labour and water-supply, not to mention capital. Jamaica is the only British possession in the West Indies that can offer these conditions, namely, in the Blue Mountains of that island.

A New Method of Preserving Fruit.—It is stated in the *Revue de Botanique Appliquée* that Dr. P. J. S. Cramer of Java has been endeavouring to discover a practical method of shipping to Europe certain tropical fruit, other than bananas and pineapples, which are also sought after as delicacies in the Colonies, but which do not keep sufficiently well to be placed on the market in France.

His method consists in smearing the fruit picked a little before maturity with a thin layer of rubber latex which in coagulating forms a protective coating around the fruit. The process of ripening is thus retarded, and the fruit, or a good part of it is preserved from the organisms causing the decay of vegetable matter.

Dr. Cramer sent a trial shipment of mangosteens (*Garcinia Mongostana*) to the Laboratoire d'Agronomie Coloniale. The mangosteen, one of the most delicate of tropical fruit only grows in very hot places—principally in Malay, Cochin China and the Antilles. It cannot be grown on the Riviera or in Algeria, nor have they succeeded in introducing it into Senegal or Tonkin. The fruit after a few days maturity goes bad and the seeds lose their germinative power almost immediately.

The fruit arrived on December 1, last in a little box, after about a month's voyage. The mangosteens were coated with a thin layer of rubber and each was wrapped in a piece of oiled paper. Sixty per cent. of the fruit were in perfect condition; the skin had the purplish tinge habitual in ripe fruit and became slightly soft to the touch. The pulp was as fresh and the taste as good as newly picked fruit.

Dr. Cramer's process of preservation is interesting and it is thought that it can be put into practice not only for the importation of fruit for cultural and acclimatization experiments but also for putting on the market new fruit from tropical Colonels.

REVIEW.

RICE: By Edwin Bingham Copeland. London: *Macmillan & Co., Ltd.* Pp. 352. Price 20s. net.

This volume by the well-known author of "The Coconut," and the first comprehensive book on rice to be published, will be appreciated by teachers, students and tropical workers who have long felt the need of a reference work on the crop in question. Information concerning this highly important food crop has been previously in a state of dispersion, and Professor Copeland has brought much of it together adding at the same time to our knowledge of the crop from his own experience gained in the Philippines, where much time and study have been devoted to rice at the College of Agriculture. Recent work in Malaya, however, has hardly been given in the book the prominence it perhaps deserves, due evidently to its being available only when the text was nearly completed.

In the first chapter the botany of rice is discussed, then follows a short one on climate, soil and water. The last mentioned might have been given more adequate treatment at this point, but the author prefers to refer to this factor, as with others, in greater detail in the chapters (5, 6 and 7) dealing with production and practices in the different countries, covering some 150 pages of the book. Diseases and pests receive attention in chapter 3; it is noted that while the crop has many potential enemies, as an industry it has never been subjected to insect and fungoid destruction in comparison with other crops. Seed and varieties is the heading of chapter 4, in which useful information especially for those interested in the improvement of rice is put forward; the difficulties in connection with variety classification are also emphasized. After three chapters on countries, already referred to, in which rice in the United States and Philippines occupy two-thirds of the space with the Far-eastern and other lands the remaining third, the volume is brought to a close with a short chapter on the uses of rice and one on the commercial, economic and social aspects of rice growing.

In conclusion, it is felt that, in a work of this kind constituting undoubtedly an important contribution to the literature on rice, much of the subject matter, especially relating to fundamental requirements, could have been presented more analytically and less descriptively, thus improving the style and arrangement at the same time adding considerably to the technical value of the book. It may be remarked that both paper and printing are well up to the high standard of excellence for which the publishers are noted.

J.S.D.

TROPICAL WORLD.

MEXICO.

The existence and increasing development of real manufacturing industries in some of the larger tropical or sub-tropical countries is often overlooked. The principal examples of countries with manufacturing industries are Central India, Southern Brazil, Queensland and Mexico. Highly important is the fact that the typical manufacturing industry of these countries is cotton spinning. This is naturally of great economic significance, especially in regard to the shifting of Lancashire's centre of gravity in respect of lower counts and the strengthening of tropical economic independence. In Mexico the largest mill is situated at Orizaba, and there are more than 100 other factories of a semi-efficient character scattered throughout the country. At present the industry is depressed and the growth of cheap cotton locally would seem to be essential. Boots and shoes are also made at two large factories in Mexico City with British capital, and there is also a considerable production of paper, cement, cigarettes and jute bags.

JAVA.

The late Lord Northcliffe wrote a glowing description of Java during his Pacific tour the winter before last and similar impressions of the high efficiency and wealth of this country with its famous system of crop Experiment Stations and central factories have on countless occasions been noted by agricultural and technical experts. It is seldom mentioned, however, that Java has a remarkable transport system in that tramways are almost as important as railways. The fact that there is about 2,450 kilometres (1 kilometre= $\frac{5}{8}$ mile) of tramway track as against 3,000 kilometres of railway affords convincing evidence that, under Javan conditions, the lighter system of transport has very special and important economic advantages. The explanation seems to be that Javan topography is such that heavy railway construction is too expensive to attract private capital; this has found an economic outlet in tramways (3 ft. 6 ins. gauge) which feed the railways which are owned by the Government. The most prosperous tramway system is that of the Kedira Steam Tramway Company which is 135 kilometres long and connects with the State line carrying the products of the sugar factories to Sourabaya harbour. Other tram lines are also largely concerned with sugar traffic. Passenger traffic is very considerable, especially near the towns and has been increasing steadily. In 1912 the total number of passengers carried on all systems was 48½ millions; a decade later it amounted to 84 millions—or an increase of almost 80 per cent. The total capital sunk in tramway construction by 1922 amounted to 155 million guilders (1 guilder=1*s.* 8*d.* at par.) against 427 million guilders invested in railways. English-made engines are largely used.

PERU.

According to information kindly brought to our notice by His Britannic Majesty's Consul at Lima, a large project is under consideration for establishing a European settlement in eastern Peru, under the auspices of a United States Syndicate. In return for a Peruvian Government concession of 40,000 square miles of cultivable land, it is proposed to build the first trans-continental transportation route across equatorial South America, using the Amazon and its tributaries for ocean steamers as the first portion of the system and a new railway across the Andes to complete the line to the Pacific. It is claimed by the promotors that this will lead to the exploration of valuable deposits of minerals and, as regards settlement, to the production of cotton, coffee and tobacco. The region suggested for settlement is apparently elevated and possesses a sub-tropical climate. An essential feature of the scheme is apparently that the labour is to be European. Concerning existing industries in Peru, which include as principal items the production of large quantities of cotton and sugar, we learn that the output of the former has of late been seriously curtailed on account of irrigation difficulties—insufficient water—and in the Piura district through the advent of a new pest whose action is similar to that of the boll weevil but whose identity is uncertain. This district (which has suffered most) is one of the smaller cotton districts, and apparently the cotton grown here is "full rough" and not of high grade. Mr. Townsend, the investigating entomologist, who was formerly in Brazil, has suggested that the so-called "smooth" variety should be planted in this district. It has been observed as would be expected, that the pest causes greater damage on poorly cultivated land than on land that receives adequate agronomic attention.

NIGERIA.

The much-needed study of the oil palm from the physiological standpoint is at last receiving the attention of the botanical section of the Department of Agriculture in this Protectorate, according to a recent report. So far, with the exception of Sumatran studies and Copeland's work on the coconut in the Philippines and a certain amount of investigational work on the same plant in Madras and Malaya, scientific workers have shown phenomenal lack of imagination in respect of what should constitute a first line of research in tropical agriculture. Practically nothing fundamental or comprehensive is known about the tropical palms. They have certainly been of economic importance sufficiently long to have become entitled to some attention other than that of the Kew description. A likely and very human reason no doubt has been the fact that it is difficult to obtain quick results with these trees, especially in regard to genetics and rythms of growth. Nigeria, the world's chief vegetable oil-field, is the centre looked to for results and initiative.

SIAM.

The chief agricultural product of this very interesting kingdom is rice. The area devoted to its cultivation in the main rice growing districts is nearly three and three-quarter million acres and the gross total crop for the year 1922-23 was 2,376,591 tons. Rice exports were approximately 84 per cent. of the total value of the exports which go principally to Singapore. Siam produces a relatively small quantity of copra but considerable pepper—which is raised on trees—and a large amount of teak varying from 50 to 60 million feet of sawn timber of which Japan is the chief purchaser. The teak industry of Siam has been the source of employment for a considerable number of Englishmen in past years and no doubt the picturesque and interesting method of logging by means of elephants has rendered this forest industry additionally attractive.

INDIA.

It is difficult to draw any general conclusions from the recent report on the Agricultural College, Nagpur, except that the College provides a training in agricultural practice and in the sciences, special attention being given, apparently, to the study and management of live stock. There is little to indicate the policy, or the standard set in the examinations, but judging by the excellent staff of external examiners it is likely to be satisfactory. It may be noted that the College is provided with a farm and a properly constructed theatre for machines, crop and stock demonstrations. The entry of students appears to be adequate and it is stated that there is a distinct demand for agricultural education in the north-east of India. The report mentions that the health conditions at the College are not particularly good owing to the increased prevalence of malaria. Concerning developments in the Punjab, Mr. W. Roberts, B.Sc., has published information of an interesting character concerning some aspects of large estate farming in that province. Large estate farming is entirely non-typical of India, and the various leases and their purposes granted by the Punjab Government are worth noting. There are several, but the largest is the Military Farms Department (21,000 acres) having for its purpose to produce fodder for the Army; next comes two 7,000 acre holdings to individuals for horse breeding, one breeding mare per square of 25 acres to be kept; another very important concession is that of the British Cotton Growing Association which holds 7,000 acres to encourage staple cotton growing, to test varieties, and to establish a buying agency for long staple cotton. It is this last named block which is managed by Mr. W. Roberts. All these farms, with the one exception, are worked upon the tenant system in which the native tenant receives half the produce and the landlord half, the water rates and land revenue and taxes which total about 9 rupees per acre being paid half by the landlord and half by the tenant. Most of the land is irrigated and in respect of cotton has yielded returns much above the Indian average. The interesting fact to note in respect of these Punjab concessions is their constructive, developmental character of an entirely different nature to the large land concessions operated by Companies in Central America.

CEYLON.

That admirable mirror of agricultural and economic progress in this Colony—the "Ceylon Observer"—has given consideration recently to the question of native education. Attention is drawn to the large and increasing number of young people who are without employment due principally to the combined effect of their disdain for agriculture and the lack of sufficient inducement to call forth enterprise even if it were potentially in existence. It is suggested that education along the lines of teaching English has been carried to an extreme, while little constructive work has been done in regard to agricultural education. Something is needed to raise the status of agriculture and this is claimed in itself to be a sufficient justification for the establishment of an agricultural College in Ceylon as distinct from a University College designed for educational research in the arts and sciences. It is refreshing to see this realization of the need for the study of agriculture as distinct from the study of the collateral sciences. Only in this way will agriculture receive the recognition it deserves—not merely as a field for experimental research—but as an actual field of social and economic activity.

GOLD COAST

In spite of the world's low price for cacao, the Director of Customs report for last year indicates a very satisfactory state of affairs in this country from the general economic standpoint. The total value of the exports (including bullion) was £8,959,212 while the imports were £8,448,862. Both showed an increase of more than half a million on the figures for 1922. The cacao crop reached another record for quantity (197,664 tons) valued at £6,566,973. There were very significant increases in the exports of kola, manganese ore, palm oil and especially cotton and gum-rubber. As regards transport, the extension of motor roads rather than of railways was the feature of the year. In 1919 there were about 1,200 miles of motorable roads; by the end of last year the mileage was over 3,200. This is important and the significance of this development of transport facilities lies in the reduced cost of getting produce down to the coast which such developments bring about. This is particularly potent in the case of railways, but holds good for roads too, since even motor haulage is cheaper than heading. Apparently there is general feeling that greater returns should be secured by cacao growers on the Gold Coast judging by the proceedings of the Cacao Growers' Conference in London, which is agitating for protection in the form of a minimum price.

ESTATE ACCOUNTANCY.

PROFESSOR W. R. DUNLOP.

[*In previous articles of this series administrative aspects, balance sheets, double-entry, valuation, depreciation and the cost-financial system have been dealt with. In this, the fifth article, the records of expenditure usually kept on estates and the way they are abstracted for regulatory and profit-determination purposes, receive attention.*]

Cost-Records and Finance.—Before we proceed to deal with the subject of record-keeping and regulatory costs it will be well to refer back to the financial ledger of the coconut estate given in the second article of this series (May issue, p.75). In that ledger we merely recorded our fortnightly expenditure in wages as a lump sum, our staff expenditure and our purchases of materials for immediate consumption each also in lump sums and after allowing for depreciation or appreciation of working assets (also in lump sums) we were prepared to take the difference between the total of the lump sums and the total receipts for sale of produce also in a lump sum, as profit. This financially, is perfectly sound, and for years has constituted the system of book-keeping taught in agricultural colleges in England and elsewhere. The system together with the balance sheet gives the owner a correct statement of the estate's financial standing and his own in respect of it, but neither at any time during the year nor even at the end of the year does the system tell him anything about what has happened internally, in what direction money and services have been expended, what different things have cost and what the same thing has cost at different stages. The system is completely devoid of analysis and internal cross-reference. But in the last article of this series we adopted a system that does analyse. We chose accounts as if they were railway stations and debited each account with the individual costs so that we might have plotted a cumulative curve of costs from the beginning to the end of the crop-financial year. We took into account inter-departmental apportionments. Such a system necessitates the keeping of detailed records not only of the journal sort used in ordinary financial book-keeping but tabular records as well. These records, however, have a two-fold or rather a three-fold value. They not only provide the information for the usual double-entry cost-financial ledger, but they also serve from day to day and week to week to tell the manager how much he is spending in different directions, the yields he is getting, and roughly, the costs per unit yield. They enable him to make comparisons as he goes along with his estimates and with his expenditure in past years. They show him in certain cases, to what extent working assets are idle and where waste is occurring. From a wider point of view these analytical records if well-defined and annually scientifically grouped, enable statisticians to contrast the management and production efficiency of one estate with another and the industry of one country with that of another country. It is the multiplicative cross-grouping, continuity and manifoldness of cost-financial and technical accounting that gives it its great potential efficiency and value.

Limitations.—Accountancy like everything else can be carried to an extreme. It is quite easy, in fact, to carry it to such a point that the system costs more than the business can possibly stand. Compromise becomes necessary—between what is ideal and what is practical. Very large estates and very small estates can get closest to the ideal; the medium-sized estate is handicapped. Yet most tropical estates (excluding small holdings which are backward on account of native intelligence) keep as a rule a remarkably good system of records. But there are criticisms. First, they are not used enough in the management of the estate and not always quite full enough to give the information essentially needed. Further, their value often breaks down owing to the gap between management and financial direction. The cost-financial idea is nearly always wanting.

Finally, except in the case of public companies, the records seldom show any attempt to distinguish between capital and current expenditure. Credit being such a dominant factor in tropical agriculture, some attempt to balance the estate's affairs at fixed intervals is clearly desirable. Moreover the balance sheet discloses evidence of appreciation and depreciation. There is too great a tendency to base this merely on yield, which, apart from specific inaccuracy due to survey deficiencies, is largely determined by climatic and other variable conditions.

Records to keep.—The records to be kept will depend upon what one thinks is necessary or worth while and upon the time and intelligence available. Most managers and owners of tropical estates to-day agree that it is necessary to keep a record of what each labourer does each day and where he does it; of stores bought and consumed and in what way; careful records of yields from different fields; a record of factory processes (costs and measurements); rainfall and other statistics. In the following paragraphs are shown sample headings of the forms and record books either in common use on estates or else recommended by experienced accountants.

Pay List (or Pay Roll).—This sheet is the most important of all and is made up usually every afternoon (or else weekly) by a book-keeper from the overseer's (or assistant's) field book (or check roll). The factory time-keeper's time-book or perhaps on some small estates the driver's note-book provide the information as well. It is important to note that all these employés are the people who record the information at its source. Without their information the book-keeper, the accountant and the manager are helpless. It is desirable to have good men at the source as well as at the finish, in accountancy. Pay Lists vary in form and there may be more than one on the same estate, *i.e.*, in field and factory work; but they are similar in principle. Following is the form of a West Indian cacao or coconut estate daily Pay List :—

PAY LIST (West Indies) Estate..... Date.....

Labourer's Name.	Occupation or job.	* No. of field or part of factory, &c.	* Size of task or No. of hours.	Amount of wages.	Remarks.

The two headings with asterisks are not usually included. They are very important, however, in cost accountancy. Next follows the daily wages pay roll made up from the field check roll on a rubber estate in the Federated Malay States (R. S. Stewart and F. C. Ebbels):—

DAILY REPORT (F.M.S. Rubber Estate). Gang..... Assistant in charge : Mr..... Date.....

No. of field.	Description of work.	No. of men employed.	No. of tasks completed.	Rate.		Amount due. Total.	Remarks.
				Per task.	Per acre.		

Rice Pay Roll.—In the Federated Malay States rice is issued usually weekly to coolies at cost and the amount (together with cash advances) deducted from their wages at the end of the month. The weekly rice pay roll takes the following form :—

RICE PAY ROLL (F.M.S. Rubber Estate—Weekly).

No.	Coolie's name.	No. of Gantangs.				Total.	Rate per Gantang.	Amount transferred to pay roll.	Remarks.	Due by coolie from last month.
		1st week.	2nd week.	3rd week.	4th week.					

Record Packing-House Supplies.—Another interesting initial set of records is afforded by those for packing-house supplies on a Porto Rican Citrus plantation, suggested by H. C. Henricksen :—

Date.	Articles.	Where obtained.	Price (cost)	Cartage.	Storage.	Total cost.
July 1	*e.g.* 1,000 boxes	On hand.				
,, 4	15 kegs nails	G. Smith & Co.				

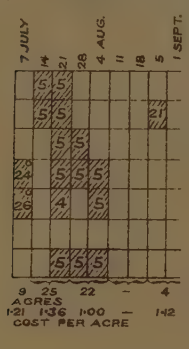
Live Stock.—Scarcely any estates in the West Indies keep a daily record of the hours worked by live stock or the milk and other products yielded by them. A record of work done by live stock is essential and might be included in the daily pay-list. Live stock are notoriously neglected in tropical estate accountancy.

Tractor Records.—Implemental tillage is now becoming so widespread in tropical agriculture that it may be of interest to present the form for tractor records (weekly) also suggested by H. C. Henricksen :—

Date.	Gasolene.	Kerosene.	Oil and grease.	Repairs.	Hours repairs.	Shop repairs.	Hours tractor worked.	*Hours breakdown and cause.	Kind of work.	Acres.

* Added to the original form

Graphic Records.—We may now conveniently refer to the value of graphic records. Below is part of one of several series of daily charts kept by a large central sugar factory in Trinidad. It shows diagrammatically the days on which subsoil ploughing was done, the number of acres and cost per acre. The card's convenient square ruling 7 x 52 [=days in the week (ordinates) and weeks in the year (abscissae)] should be noted. The graphic method has also been demonstrated by the writer as valuable for inventories of plantation trees, each intersection of conveniently ruled lines representing the planting position (piquets). Trees of different ages or productivity can be represented by numbered or coloured-headed pins and changed from time to time. Incidentally the area of the planted acreage can be readily calculated from such a chart if the trees are in reasonable alignment and reasonably equi-distant. Cumulative costs, factory data, rainfall, yields, &c., can also with advantage be displayed graphically in the estate office. When it is desired to compare rates of increase from day to day between items of greatly differing magnitude (*e.g.*, production and waste) antilog paper is invaluable.* Card indices are also useful for filing certain information for quick reference.



Abstracting.—Every planter knows what is meant by the daily, weekly or fortnightly abstract or analysis. The process consists in picking out items from pay lists and other daily records and grouping them under convenient and significant headings. Abstracting is really a form of ledger-posting such as we are familiar with in ordinary double-entry. It is a kind of intermediate process between the initial recording of information in the field or factory and the final treatment of the information by the accountant or financial director.

Fortnightly Abstract.—The following is the form of an abstract used on a well-cultivated Trinidad cacao estate :—

	Amount.	Previous Fort'ht.	Total to date.
Staff and Superintendence. (Sub-heads :—Manager's salary, &c.).			
Stock. (Sub-heads : — Purchase of new stock, vehicle taxes, &c.).			
Cultivation. (Sub-heads:—Supplying, weeding, manuring, destroying pests, &c.).			
(Carried forward.)			
(Brought forward).			
Reaping. (Sub-heads : — Picking, breaking, crooking and carting, &c.).			
Manufacture. (Sub-heads : — Drying, cartage, freight, supplies, &c.).			
Buildings. (Sub-heads:—Roads and bridges, taxes (house and land), &c.).			

In addition, the form gives an abstract of the crop (no. of barrels of wet cacao, no. of bags cured cacao shipped this fortnight and to date, and cost per barrel). An enumeration of the number of live stock is also registered but not of their work. Consideration of the above will show that several of the heads and sub-heads are defective in respect of their grouping and definition. Further there is no inter-sectional apportionment. The above constitutes practically all the accounting done in the estate in question which is above the average Trinidad cacao estate in respect of efficient management. Next we give a few headings taken from a Trinidad sugar estate and factory (10,000 tons of sugar output).

FORTNIGHTLY ABSTRACT.—(Sugar Estate—privately-owned.)

Description of work.	Amount.	Previously.	To date.
Overlookers			
Clearing lands ..			
Cutlassing to plant ..			
Children's nurse ..			
Coffins and graves ..			
Scrubbing and white-washing hospital ..			
Factory labourers, &c.			

There are 150 items in this abstract in all, ranging from coffins and graves to the purchase of a vacuum pan! The abstract includes a special live stock return and artificial and pen manure account as well as an account for "Credits." Total receipts *minus* total expenditure=profits. This form prevails on an estate with a capital value of something like a million dollars.

Monthly Abstracts.—On some estates the final abstract is made up monthly. This is common in the East on the rubber and tea estates. We may consider West Indian monthly abstract of a mixed estate (cacao and sugar-cane) in Grenada. This has the following heads : Salaries, Cacao, Canes, Miscellaneous, with in all 47 sub-heads of expenditure (operations, &c.). The *total* of all these, irrespective of whether they be connected with cacao or sugar-cane and irrespective of purchase of stock, &c. (assets), is used to determine the profit made simply by substracting this total from the total receipts for sale of produce at the

* The study of estate records plotted as curves comes under mathematical statistics

end of the year. In other words as in the case of the sugar estate, balance at bank at the end of the year is the profit or loss. But when we come to consider a monthly abstract or report of an Eastern rubber estate we find a very different system. (Note the estimate columns, always desirable) :—

MONTHLY REPORT (Ceylon Rubber Estate—from information furnished by Mr. Herbert Wright).

Analysis No.	Description of items.	Rs.	Cts.	No.	Headings.	Days labour.	Amount.	Total this month.	Brought forward.	Total this year.	Cost per lb.	Estimate.	Estimated per lb.
32	Check rolls, collecting latex (Rs.——); tapping (Rs.——); transporting E. Levant latex (Rs.——).			32	Tapping.								

The tapping entry is given merely to indicate the detail : Heading 32 is analysed under 32 in first column. There is also a section on this sheet for capital expenditure. On the back of the sheet, ruled forms occur for the insertion of the following information : (*a*) Statement of coolies (no. on estate) ; (*b*) Acreage and no. of trees ; (*c*) Dry rubber manufactured daily with daily rainfall ; (*d*) Wet or dry rubber this month and to date ; (*e*) Progress of work (acres weeded, drained &c.) ; (*f*) Rice account ; (*g*) Despatches of rubber and amount in store ; (*h*) Stocks = (Stores= packages, hoop-iron, nails, &c.) ; (*i*) Oil engine account ; (*j*) Rubber made for others (outside estates) ; (*k*) Superintendents Account Current (cash) ; (*l*) Cash balance sheet. Provided certain extra information in respect of apportionments to different fields, &c., valuations and other data are available at the Company's Head Office, these monthly reports appear to provide all the information needed for regulating expenditure and for the preparation of a cost-financial statement at the end of the year.

Recapitulation.—In this article we have endeavoured to explain how estate costing records are collected and abstracted. Because of the great geographical range, and because of the diversity of size and conditions in regard to tropical estates it has only been possible to present more or less fragmentary indications of the kind of recording and accounting that is done. No reference has been made to records for native cult vators. This was dealt with in our second article this Journal for May). In considering the forms in use described in the present article, what we have to decide is, whether the records are kept with the principles of accountancy as laid down in previous articles, in view. If not, what is the primary aim ? The aim usually is merely to keep a check on expenditure and revenue. The sugar estate abstract given above is typical of this idea but not typical of estates of its size. Nevertheless defective principles underlying the keeping of records are common, at least in the West Indies. What seems to be needed is a series of accountancy congresses for each plantation industry—sugar, rubber, coconuts, cotton, &c., in order to establish conventions as to principles and definitions of what each cost should include. It is essential to realise that "cost" and "current expenditure" are not the same thing. It is one of the objects of these articles to bring out this point. A check generally is, and always should be kept on expenditure in different directions, but this does not furnish costs. Costs are retrospective. In addition to labour charges in any particular cost, there are depreciation, supervision, taxation and often an apportionment of other "costs" which, like cattle, are not directly productive. It is not always practicable to account accurately in this way, but the principle recognized in the manufacturing industry should be accepted. Below is an abstract showing "cost" of *manufacture* of a ton of sugar in a small-sized central factory in 1923 :—

Total tons made.	Oil and stores.	Bags.	Chemicals.	Fuel.	Labour	Total.
5210	4/5½	12/11½	1/0½	8/8	19/1	46/2½

Labour was found to include labour on railway and wages of factory mechanics. Such figures are misleading for statistical purposes nor do they represent the true costs from the estate point of view. Again in regard to the cost of production of rubber, the following shows how great is the lack of uniformity in the final results on different estates or groups of estates (the figures have been selected from recent Company Annual Reports) : Instance A—Cost per lb. 8·23*d.* (f.o.b., including depreciation, staff commission, &c.) ; Instance B—Cost per lb. 7·926*d.* (including selling charges and home expenses) ; Instance C—Cost per lb. 8·75*d.* (f.o.b. at port of shipment including depreciation, commission to staff and London administration) ; Instance D—Cost per lb. 10·42*d.* (including the whole of the administration expenses) ; Instance E—cost per lb. 7·52*d.* (f.o.b. including 2c. export assessment). It becomes impossible usefully to compare costs of this nature. As already stated the whole question of costs and estate accountancy needs to be considered in conference on the single industry basis.

(To be concluded.)

COCONUTS ON CLAY SOIL.

[*This article is based on two visits of inspection to the Trinidad southern (Cedros) District which is the island's chief coconut district, producing at present some* 24,000,000 *nuts out of the Colony's total of about* 35,000,000.]

A visitor from the Federated Malay States to Trinidad once remarked that the thing which struck him most in the Cedros coconut district was the large amount of attention given to field sanitation. This impression was doubtless formed in the clay soil areas, such areas being, all over the world, notoriously antagonistic to high yield and vegetative vigour in the case of the coconut.

Other than the occurrence (in places) of this clay soil condition, Cedros district has all the economic and natural advantages for successful coconut production, including proximity to the sea (for transport), good roads, labour supply and rainfall. (Ten-year average rainfall at a central point is 58 inches per annum with 2 to 4 inches per month in the dry season and about 7 inches per month in the wet—June to August.) In one or two places as at Icacos—the extreme south-eastern point—all the conditions for coconuts are ideal; for the soil which joins the beach is flat and sandy and very fertile with a slowly but constantly moving water-table 3 feet below the surface. Here the trees need but little attention other than routine weeding and manuring to produce 5,000,000 nuts from 1,000 acres, or at the rate of 80 nuts per tree per annum. Most of the large estates in the district are 800 to 3,000 acres in area, and of these there is one, especially, which, owing to its clay soil has been rendered productive only with great difficulty. The estate is very appropriately named. It is called Perseverance and is under the management of Mr. Romer Johnstone. The fact that the 800 planted acres are now giving on an average nearly 1,250,000 nuts is remarkable. The trees on this estate take 11 to 14 years to come into bearing (against the Trinidad averages of 7 or 8); but the most serious circumstance is that a considerable proportion fail to pass into the bearing stage owing to the effects of red ring disease (caused by a nematode worm widely distributed in the New World tropics); this, together with bud rots, has caused or occasioned the death of some 1,500 trees per annum during the years of first bearing. Moreover those trees which have developed can only be credited with providing but the minimum economic yield. In spite of this the productivity of the estate has been steadily improving, the number of trees lost has decreased, and on account of the good prices for coconut products the estate has been able to show a profit of several thousand dollars per annum during the last 2 or 3 years.

In respect of soil improvement, the main objective has been to provide good drainage. As much as $1,900 has been spent in a single year on drainage, and the principal idea has been not so much to drain the water off the estate (for the rainfall is not excessive), but rather to keep the water moving and to prevent stagnation around the base of the trees and the area of functioning roots. The trees have responded to this water-control drainage though the cost has been considerable. Further, experiments have been made in respect of liming, ploughing and green dressings (with Tephrosia), while the earthing up of the trees and manuring with pen manure have been systematically practised.

In regard to disease, great vigilance has been maintained in respect of red ring and bud rot and trees have been felled and burnt immediately fatal symptoms have been observed. The large percentage of trees cut down has been noted. The only possible criticism in this regard is whether this loss has been properly accounted for from the financial standpoint.

Concerning mechanical injuries to the trunks (caused in the past by wanton destruction by labourers now put a stop to), the procedure is to treat them surgically and dress the wounds with crude oil. The same applies to "bleeding stem." But the main concern are the bud diseases, and the fact that early maturity, high yields with practically no deaths characterises the estates in the same neighbourhood with lighter soil, makes it safe to conclude that the disabilities of Perseverance estate are bound up in the direct and indirect effects of clay.

The moral is two-fold and far-reaching: Firstly, it is unwise to plant coconuts on clay soil; but, secondly, if it is done, those responsible must be prepared to be penalised in the form of having to spend money and energy and devote intelligent supervision in order to bring about a return on the capital invested. Perseverance and also other estates with clay soil in the Cedros district afford good examples of what can be achieved under unfavourable conditions even with such a slow cumbrous and unaccommodating crop as the coconut.

Clay soil has one other adverse influence in this district: indirectly it is the cause of much hookworm and malaria amongst the labour. The prevalence of these human diseases is as all over the tropics, closely associated with the bad drainage and taking a wide view, the money spent on the drainage of the fields should not be debited to crop sanitation account only but also to human sanitation account as well. A gratifying feature of Perseverance estate is, generally speaking, the satisfactory condition of the labour both morally and physically in spite of soil disadvantages. The management cares for its people as well as for its trees. Much trouble is taken in the microscopic diagnosis and treatment of individual cases of hookworm by the administration of chenopodium. This like the plant pathological work is all done by Mr. Johnstone himself. In addition fresh milk is provided free, every day, for mothers with infants and for sick labourers. Recreation is also encouraged and assisted: most of the Cedros estates have adopted the admirable system

of providing sports grounds where inter-estate cricket matches are regularly played. These matches in which the labourers (mostly East Indians) take part do much to lessen the monotony of existence, provide healthy exercise and promote good will and interest amongst all concerned.

THE TROPICS AT WEMBLEY.

There is a tendency amongst people not directly concerned with the production, manufacture and commerce of tropical produce to regard these commodities as being somewhat in the nature of luxuries and novelties—Nature-provided blessings—or at all events as being free that individual economic importance universally recognised in the case of such substances as coal and iron. Even if at the Imperial Exhibition Engineering and the magnificent and extensive displays of the Dominions—especially Canada—tend to eclipse the produce of the tropics it is evident that the best educated minds are alive to the tendency called attention to above. The "Birmingham Post" for example, has given the matter very pertinent consideration realizing the large amount of manufacture (for overseas marketing) that is necessary and is effected in the tropics and realising the economic importance of tropical products in northern countries. In the course of an article on the produce of the tropics it is stated :—"Their produce enters deep into our homes and industrial processes, and one can follow to their sources many every-day commodities which come by sea from these tropical possessions.

"Cocoa will be found prominent, especially in the Gold Coast, which produces half the total consumption of the world. In the West Indies cocoa may be bought, either in the form of hot or iced drinks, or in boxes of chocolates. This is a real illustration of Imperial trade, self-contained at Wembley, for the confections on sale in the West Indies pavilion are made in the Palace of Industry, where the manufacturing process can be seen in operation. Palm oil, which has so rapidly become a staple English food in one form or another, is being extracted by a modern plant in the Nigerian building, and sugar-canes and the partly refined muscovado sugar figure in the West Indies. Such essentials of industry as fuel-oil, lead, zinc, wolfram, and tin will be found in the beautiful Burma building; the Gold Coast shows the recently-developed manganese which played so great a part in the war, and across the Atlantic once more we find balata, the tough substance used for insulation purposes, factory belting, and footwear. Ceylon and Malaya compete in displaying the process of rubber extraction, from the bleeding of milky juice of the trees to the partly-finished product—the raw material for other processes here."

Another very suggestive and valuable discussion of the tropics at Wembley appears in a recent issue of "Nature." This deals with the subject from an ethnological standpoint. The tendency amongst the British public to underestimate and to regard coloured people as merely of spectacular interest is deprecated. The large number of graduates turned out each year from tropical colleges such as those in Sierra Leone, Ceylon and Barbados and from Universities in India is referred to as an indication that the natives of the tropics are at least able to assimilate intellectual instruction like ourselves.

COLLEGE NEWS.

Dr. Martin Leake, M.A., SC.D., is expected to arrive in Trinidad towards the end of August. Professor H. A. Ballou is acting Principal and Commissioner of Agriculture.

Professor Dash left Trinidad on July 7, by Royal Mail Steamer for Canada on vacational leave.

Members of the Naparima (District) Agricultural Society paid a visit to the College on Saturday, July 19. They also visited the Government Experiment Station and Stock Farm.

Professor Dunlop made a tour of estates in the Southern District at the beginning of July in connection with estate economics.

Next Session begins on September 29.

College continues open for research.

TROPICAL METHODS OF STATISTICAL ENQUIRY.—On May 15, 1924, the Economics Department of the Imperial College of Tropical Agriculture sent out 500 letters to individual cacao estates in Trinidad selected at random from the 900 odd listed in Franklin's Trinidad Year Book 1924. These letters, addressed in each case to the "Manager or Owner," contained in simple language a personal request with reasons and motives, for data as to rainfall, yield and number of trees for the past three years. A printed form of the simplest description was provided, and it was stated in each letter that if the estate did not keep rainfall records, those of the nearest one that did or those of the nearest Constabulary Station would do. The letters sent out contained an officially stamped and addressed envelope in which to return the forms.

By July 15, the position was as follows :—

No. of forms returned properly filled in ..	21
Do. do. incompletely filled in ..	3
Do. letters returned by G. P. O. as unclaimed	125
Do. do. presumably received but unacknowledged ..	351

It was fully realised owing to the fairly high percentage of peasant proprietors, postal and other reasons, that the above method was not likely to prove successful from the point of view of getting the data required. But the experiment was considered to be worth while from the point of view of testing a common statistical method of inquiry under tropical conditions utilising public services and information for the purpose.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—During May and June and July sugar has been a very weak market. West Indian sugar (96°) 20*s.* 6*d.* per cwt. c.i.f. (July 17). White Java c.i.f. 22*s.* 3*d.* (July 15).

CACAO.—There has been some interest in the finer sorts like Ceylon but generally the market has been very dull and quiet the last two months. Accras (fermented) 30*s.* per cwt. Trinidad 53*s.* July 15. Trinidad \$9¼ to \$9½ (local) on July 15.

COTTON.—Fully middling at Liverpool was 17·64*d.* per lb. June 12, which is a fall from the price at the end of May. Middling Upland Liverpool 16·48*d.* (July 15.)

COFFEE.—The effect of the Brazilian revolution is certain to be significant and will probably tend to raise prices. Santos was 84*s.* at June 18, a decline from last month.

TEA.—Ceylon tea has been in over-average use and request. The tone of the tea market distinctly improved during June except for the coarser lots. Indian average 18¼*d.* per lb.

SISAL.—Value of prime sisal has declined somewhat since last issue : £47 per ton June 18. Manila hemp £40 per ton.

RUBBER.—This produce has continued to decline in value. Price 10*d.* per lb. for good quality at end of June.

RICE.—Quiet, but values for Burmese steady at £15 10*s.* per ton.

COPRA.—Ceylon copra has been steady at £29 10*s.* per ton. Firmer tone for copra in July. West Indian copra \$4.96 per 100 lb. in Trinidad (July 18.)

VEGETABLE OILS.—The dull tone of two months ago has improved somewhat in respect of castor, palm kernel, palm oils. Palm oil (Lagos) 37*s.* ; Palm kernel : deodorised 50*s.* (June 18.)

CITRUS PRODUCTS.—Concentrated lime juice neglected with sellers at £23 ex wharf. Raw rather scarce. Handpressed oil 8*s.* 3*d.* Orange oil dull, 9*s.* 3*d.* asked. (June 17.)

HIDES.—8¼*d.* per lb. (June 18.)

FERTILIZERS.—Sulphate of ammonia 14*s.* 6*d.* per cwt. Nitrate of soda 14*s.* per cwt. Sulphate of potash 11*s.* 3*d.* per cwt. and Muriate of potash 7*s.* 6*d.* per cwt at June 18.

SPICES.—Prices for ginger are dearer and the few cheap sellers have entirely withdrawn. The lowest quotation for African is now 80*s.* per cwt., and Cochin which was offered last week at 90*s.*, is now held for 95*s.* per cwt. (Friday, June 28.)

CORRESPONDENCE.

THE PACKING OF RUBBER.

To the Editor of "Tropical Agriculture."

Sir,

A consignment of rubber was shipped a few months ago to London from a Trinidad estate in which I am interested, each sheet being dusted with powdered chalk.

I have not been able to discover who was responsible for this nor can anyone say how the idea arose. It may have arisen, however, from the recommendations referred to in your note in "Tropical Agriculture," for last February, page 29.

The point which concerns me is that the rubber was valued at 10*d.* per lb. (the market price at the time for good smoked sheet), but the rubber actually fetched only 9*d.* the discount 10% being demanded (so I am told) because of the chalk, which my brokers say has to be carefully removed at considerable expense before the rubber can be manufactured.

I should be interested to know what authority made the recommendations referred to in "Tropical Agriculture," and how this authority reconciles its advice with the results of my experience.

Yours faithfully,

G. TOWNSEND FENWICK.

Port-of-Spain, Trinidad,
July 10, 1924.

[The note referred to by Sir Townsend Fenwick was based on information published in the "Bulletin of the Rubber Growers' Association (Incorporated)" for September 1923 *et seq.*, in which Dr. C. W. Geer, Vice-President of the B. F. Goodrich Company is stated to confirm the recommendation of the Rubber Growers' Association Delegates' Report which advocated the use of wrappers and French chalk in the packing of rubber for export.—Ed. *T. A.*]

Written enquiries concerning the Imperial College of Tropical Agriculture have been received from the French Government, through the French Consul in Trinidad, with special reference to Cotton-growing. Enquiries have also been received from the Republic of Guatemala and from Fiji.

WHAT CONSTITUTES A SATISFACTORY MARKET PRICE.—To the producer looking forward, a satisfactory market price is that which will leave him a reasonable profit at his estimated cost of production per unit weight of produce. There is a certain price limit below which, even with good yields per acre, it cannot pay to produce, and when prices are near or are approaching this limit the market is bad. On the basis of this definition we can put the current prices of certain of this page's commodities into two categories from the West Indian standpoint :—

(*a*) Satisfactory : Coffee, copra, coconuts.
(*b*) Unsatisfactory : Cacao, sugar and rubber.

It will be noted that the above is from the West Indian standpoint. Countries which have lower *costs* can of course stand up to lower *prices*.